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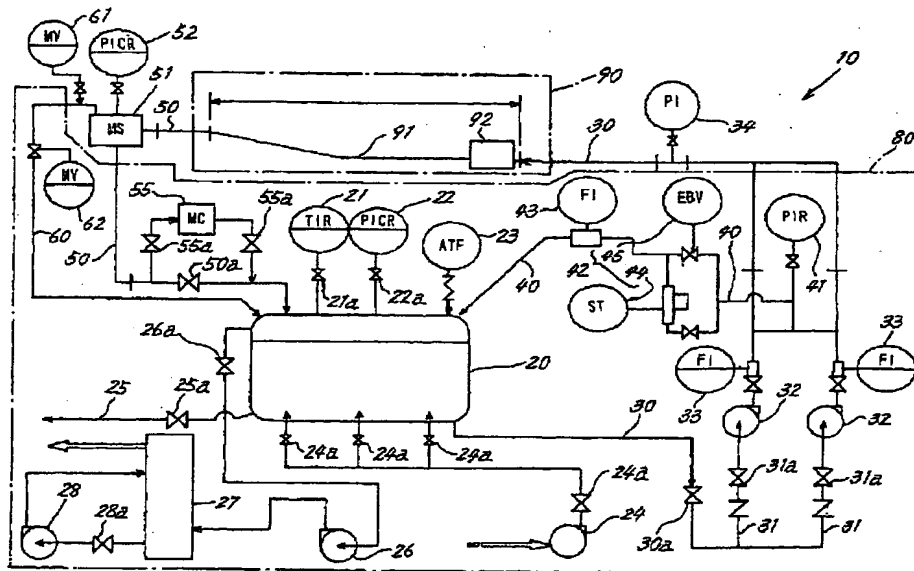
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(54) Title: WASHING SYSTEM FOR DRAIN PIPE INSIDE MOBILE FRAME

(54) 発明の名称: 移動機体内の排水管の洗浄システム



(57) Abstract: A system capable of removing scales by washing out a drain pipe in a short time without disconnecting the drain pipe from a mobile frame, comprising a fluid storage tank having washing fluid stored therein, a fluid feed pipe connecting the fluid storage tank to the downstream side of the drain pipe of the mobile frame and having a feed pump means for feeding the washing fluid from the fluid storage tank to the downstream side of the drain pipe, a suction pipe connecting the upstream side of the drain pipe to the fluid storage tank, and a vacuum pump means sucking gas from the fluid storage tank, wherein a gas separating means for separating gas from among the gas,

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liquid, and solid sucked from the drain pipe is installed in the suction pipe, and an intake pipe connected parallel with the suction pipe and returning the separated gas to the fluid storage tank is disposed between the gas separating means and the fluid storage tank.

(57) 要約:

移動機体から排水管を取り外すことなく、短時間で排水管を洗浄して、スケールを除去できるシステムを提供する。洗浄液が入れられた貯液槽と、該貯液槽と移動機体の排水管の下流側とを連結し、貯液槽から排水管の下流側に洗浄液を送り込む送給ポンプ手段を具えた送給管と、排水管の上流側と貯液槽とを連結する吸引管と、貯液槽内から気体を吸引する真空ポンプ手段とを具えており、吸引管には、排水管から吸引された気体、液体及び固体の中から、気体を分離する気体分離手段を設け、気体分離手段と貯液槽との間には、吸引管と並列に接続され、分離された気体を貯液槽に戻す吸気管を配設して構成される。

## 明 細 書

## 移動機体内の排水管の洗浄システム

技術分野

本発明は、旅客航空機等の移動機体内に設置される配管の洗浄、具体的には、化粧室の洗面台やトイレ等の排水管の内部に付着したスケールを除去するシステムに関するものである。

背景技術

旅客航空機等の移動機体内には、化粧室の洗面台やトイレの便器などに排水管が配設されている。排水管には、その使用により、内部にカルシウム系化合物や有機化合物(以下これら堆積物を「スケール」と称す)が堆積する。スケールが堆積すると、排水能力の低下や詰まり、臭い等の原因となるため、定期的に除去する必要がある。

従来のスケールを除去する方法では、排水管を移動機体から取り外して、専用の洗浄装置が設置されている場所まで運んで洗浄し、洗浄完了後、再度、移動機体まで運んで取り付けるというものであった。

移動機体は、内部が複雑な構造をしており、さらに、排水管も様々な方向に屈曲しているから、排水管の取外し及び取り付け作業は困難を極め、膨大な時間、手間及び費用が掛かる。このため、排水管の洗浄作業は、定期整備の際にしか実施できなかったため、次の定期整備までの間に、スケールが徐々に排水管に堆積して排水能力が低下したり、突発的な排水管の詰まりが発生することがあった。

そこで、排水管等を取り外すことなく、短時間で排水管の洗浄を行なうシステムの開発が強く要望されていた。

本発明の目的は、移動機体から排水管を取り外すことなく、短時間で排水管を洗浄して、スケールを除去できるシステムを提供することである。

### 発明の開示

上記課題を解決するために、本発明の移動機体内の排水管の洗浄システムは、

洗浄液が入れられた貯液槽と、

該貯液槽と移動機体の排水管の下流側とを連結し、貯液槽から排水管の下流側に洗浄液を送り込む送給ポンプ手段を具えた送給管と、

排水管の上流側と貯液槽とを連結する吸引管と、

貯液槽内から気体を吸引する真空ポンプ手段とを具えており、

吸引管には、排水管から吸引された気体、液体及び固体の中から、気体を分離する気体分離手段を設け、

気体分離手段と貯液槽との間には、吸引管と並列に接続され、分離された気体を貯液槽に戻す吸気管を配設して構成される。

上記移動機体内の排水管の洗浄システムでは、送給ポンプ手段と真空ポンプ手段を作動させ、排水管内を負圧状態に維持しつつ、貯液槽から送給管を通じて排水管内に洗浄液を送り込み、排水管の上流側へ向けて洗浄液を流動させて、排水管中に付着したスケールを取り除き、取り除かれたスケールを洗浄液と共に吸引管から吸引する。吸引管に吸引された気体、液体及び固体は、気体分離手段にて気体のみが分離され、液体と固体は吸引管を通じて貯液槽に戻されると共に、気体は吸気管から貯液槽に戻される。

排水管の内部は、負圧に維持されるから、洗浄液等が排水管の外部に漏れ出すことはない。また、洗浄液を、通常の排水管の排水方向とは逆

向き、つまり、排水管の下流側から上流側に向けて流すことにより、スケールの成長方向に対して、逆向きのエネルギーが加わり、スケールの剥離が促進される。従って、スケールの除去及び洗浄効果を高めることができる。

また、気体分離手段により、吸引管中で気体が液体及び固体と分離されるから、吸引管内で、気体が気泡となって逆流したり、液体及び固体の流動を妨げることもない。

本発明の移動機体内の排水管の洗浄システムは、送給ポンプ手段の下流側に、送給管から分岐し、貯液槽に接続される戻し管が配設され、該戻し管には、送給管を通して排水管に送給される洗浄液の圧力をほぼ一定に保持し、洗浄液の圧力が所定値を越えたときに洗浄液の一部又は全部を貯液槽に還流する戻し弁装置が設けることができる。

上記移動機体内の排水管の洗浄システムによれば、送給管から排水管に送給される洗浄液の圧力が、所定値を越えたときに、戻し弁装置を開いて、洗浄液の一部又は全部が戻し管から貯液槽に戻るようになっているので、所定圧力値を超える洗浄液が排水管に流入することはい。

本発明の移動機体内の排水管の洗浄システムは、吸気管に、気体分離手段の下流側に外気を導入する外気導入弁手段と、該外気導入弁手段の下流側に、吸気管を閉じて貯液槽への気体の流入を阻止する気体流入阻止弁手段とを具えることが望ましく、通常運転時には、外気導入弁手段を閉じ、流入阻止弁手段を開き、排水管内部の圧力が所定値を越えたときに、排水管の内部の圧力を調整するために、外気導入弁手段を開くと共に流入阻止弁手段を閉じる。

上記移動機体内の排水管の洗浄システムによれば、排水管中で洗浄液の流れが悪くなったり、詰まったりして、排水管の内部圧力が所定値を越えたときに、外気導入弁手段を開くと共に流入阻止弁手段を閉じる。

これにより、外気導入弁手段から吸入された外気が、吸気管から貯液槽に流れ込むことなく排水管に導かれるため、排水管内部の圧力が大気圧に維持されて、排水管から外部へ洗浄液等が飛散することもない。

本発明の移動機体内の排水管の洗浄システムは、吸引管には、気体分離手段と貯液槽との間に、固体を分離する固体分離手段が並列に接続することが望ましい。

上記移動機体内の排水管の洗浄システムは、固体分離手段を具えているから、洗浄中、必要に応じて、洗浄液から固体成分を分離し、液体成分のみを貯液槽に還流することができる。

本発明の移動機体内の排水管の洗浄システムは、洗浄液に、固形のチップを含むことが望ましい。

洗浄液の内部に固形のチップを含むことにより、スケール成分中の有機化合物等にチップがあたると、排水管内の有機物や嫌気性バクテリア等を除去することができる。

本発明の移動機体内の排水管の洗浄システムは、洗浄液には、オキシカルボン酸を少なくとも一種以上と、スルファミン酸を少なくとも一種以上含むことが望ましい。

洗浄液として、オキシカルボン酸を少なくとも一種以上と、スルファミン酸を少なくとも一種以上含むことにより、スケール成分中のカルシウム化合物を溶解して除去するのに特に好適である。

また、本発明の車輛は、上記移動機体内の排水管の洗浄システムを搭載している。

車輛に、上記移動機体内の排水管の洗浄システムを搭載することにより、移動機体が駐機している位置まで移動して、排水管の洗浄を行なうことができる。従って、移動機体の排水管を洗浄するために、移動機体を所定の場所まで移動させる必要がない。

### 図面の簡単な説明

図 1 は、本発明の洗浄システムの構成を示す説明図である。

図 2 は、気体分離手段の断面図である。

### 発明を実施するための最良の形態

洗浄の対象となる排水管が配設される移動機体として、旅客航空機や鉄道の車輛、バス、船舶などを例示することができる。

移動機体(90)には、図 1 に示すように、排水管(91)が配備されている。排水管(91)は、複数配備され、各排水管の上流側は、化粧室の洗面台やトイレの便器などに連結されており、下流側は共通の汚水槽(92)に連結されている。

図 1 は、洗浄システム(10)の全体構成を示しており、図示の如く、洗浄システム(10)は、洗浄液 L が入れられた貯液槽(20)と、移動機体(90)の排水管(91)との間を、送給管(30)及び吸引管(50)で接続してなる構成である。

貯液槽(20)は、トラック等の車輛(80)に搭載できる。貯液槽(20)には、洗浄液 L を移動機体(90)の排水管(91)に送り込む送給管(30)が洗浄液 L の液面よりも下側に接続されており、後述する戻し管(40)、吸引管(50)及び吸気管(60)が洗浄液 L の液面よりも上側に接続されている。さらに、貯液槽(20)には、貯液槽内部の温度を測定するための温度計(21)、圧力を測定するための圧力計(22)が弁(21a)(22a)を介して夫々配備されており、洗浄により有害なガスや燃焼性ガスが発生したときに貯液槽内部に外気を送り込むエアトランスフォーマ(23)、貯液槽(20)内の洗浄液 L を攪拌するブローア(24)及び溶解槽中の洗浄剤 L を排水するためのブロー管(25)が弁(24a)(25a)を介して夫々接続されている。

貯液槽(20)に入れられる洗浄液Lは、移動機体(90)の排水管(91)に付着するスケールの成分、量、排水管(91)の形状等によって種々選択することができる。例えば、旅客航空機の場合、排水管に堆積するスケールの成分は、カルシウム化合物、有機化合物及び嫌気性バクテリアが大半を占める。スケール中のカルシウム化合物を除去するには、オキシカルボン酸を少なくとも一種以上と、スルファミン酸を少なくとも一種以上を含む洗浄液を用いることが望ましい。また、有機化合物及び嫌気性バクテリアは、カルシウム化合物の上にスライム状に付着していることが多いため、洗浄液Lに固形のチップを混入しておき、付着している有機化合物等を削り取るようにすればよい。洗浄液に混入する固形のチップとして、もみがらやシリコン製の粒状体を例示できる。

排水管(91)に洗浄液Lを送り込む送給管(30)は、移動機体(90)の排水管(91)の下流側に接続される。送給管(30)は、図示の如く、移動機体(90)の汚水槽(92)に接続してもよい。

送給管(30)は、弁(30a)の下流側で2本に分岐し、各送給分岐管(31)(31)には、夫々弁(31a)(31a)を介して送給ポンプ手段(32)(32)が配備されている。送給ポンプ手段(32)(32)の下流側には、流量計(33)(33)が配備されており、送給ポンプ手段(32)(32)から排水管(91)へ送給される洗浄液Lの流量を監視している。送給管(30)を分岐して送給ポンプ手段(32)(32)を2基設けたことにより、各送給ポンプ手段の揚程力を小さくでき、また、送給量の安定化を図ることができる。さらに、一方のポンプ手段が壊れても他方の稼動により洗浄液Lを送給できる。

送給分岐管(31)(31)には、流量計(33)(33)の下流側に戻し管(40)が接続されている。戻し管(40)については後述する。

送給分岐管(32)(32)は、戻し管(40)との分岐位置よりもさらに下流側で再度合流しており、合流した送給管(30)は、圧力指示計(34)を介して、



先端が、移動機体(90)の排水管(91)に接続される。

戻し管(40)は、送給分岐管(31)(31)から洗浄液Lの一部又は全部を貯液槽(20)に戻す管である。戻し管(40)は、途中で2本に分岐し、再度合流している。分岐位置よりも上流側には、圧力計(41)が配備され、分岐部分に戻し弁手段(42)、合流後の下流側に流量計(43)が配備されている。

戻し弁手段(42)は、分岐した一方に配備された溶液圧力調整用の戻し弁(44)と、他方に配備された非常用の戻し弁(45)を具える。溶液圧力調整用の戻し弁(44)は、圧力計(41)及び送給管(30)の流量計(33)(33)の測定値に応じて、送給分岐管(31)(31)を通る洗浄液Lの一部を貯液槽(20)に戻し、送給管(30)から排水管(91)に供給される洗浄液Lの圧力及び流量を一定に保つ役割をなす。また、非常用の戻し弁(45)は、洗浄システム(10)中に存する圧力計が所定値よりも高い圧力を示したときに開いて、送給管(30)から排水管(91)へ洗浄液Lが流れ込むのを阻止する。

吸引管(50)は、一端が、移動機体(90)の排水管(91)の上流側、つまり、洗面台や便器側に接続され、他端が、貯液槽(20)に接続されている。

排水管(91)から排出された洗浄液L、排水管内のスケール、気体成分等が流体廃液となって吸引管(50)から吸引される。

吸引管(50)には、気体分離手段(51)が配備されており、廃液から気体成分を分離し、気体成分を吸気管(60)、液体及び固体成分を吸引管(50)を通して、貯液槽(20)に戻す。気体分離手段(51)には、圧力の指示、調節及び記録を行なう計測器(52)が配備されている。

気体分離手段(51)として、図2に示すように、下端が縮径した円筒状容器(53)の略中央に斜め下向きにじゃま板(54)を設けた装置を例示できる。該装置は、移動機体(90)の排水管(91)から吸引された廃液をじゃま板(54)に当てて、重力作用により、気体成分を上側、液体及び固体成分を下側に分離する。分離された気体成分は、上部に連結された吸気管(6

0)から貯液槽(20)に戻される。液体及び固体成分は、円筒状容器(53)の下端に接続された吸引管(50)を通して、貯液槽(20)に戻される。

吸気管(60)には、気体分離手段(51)の下流側に外気導入弁手段(61)、気体流入阻止弁手段(62)が順に配備されている。これら弁手段(61)(62)は、いずれも排水管(91)の内部圧力が所定値を越えたときに、排水管(91)に外気を導入して排水管(91)の内部の圧力を大気圧に戻し、排水管(91)の内部が高圧になるのを防止する。外気導入弁手段(61)は、吸気管(60)から外気を吸引管(50)を通して排水管(91)に導入する弁であって、通常の運転状態では閉じられており、排水管(91)の圧力が所定値を越えると開く。一方、気体流入阻止弁(62)は、外気導入弁手段(61)が開いたときに、外気導入弁手段(61)から導入した外気が、吸気管(60)から貯液槽(20)に流れ込むことなく、排水管(91)側へ流入するように、吸気管(60)を閉じるもので、通常の運転状態では開いている。

吸引管(50)には、気体分離手段(51)の下流側に弁(50a)が配備されており、該弁(50a)と並列に固体分離手段(55)が配備されている。

固体分離手段(55)は、気体分離手段(51)で分離された液体及び固体から、液体と固体を分離し、液体のみを吸引管(50)に戻す手段であり、上流側と下流側には弁(55a)(55a)が配備されている。固体分離手段(55)として、フィルターを例示することができる。

弁(55a)(55a)を開いて、弁(50a)を閉じると、吸引管(50)を流れる流体は、固体分離手段(55)側に流入し、固体成分が分離された後、液体成分のみが貯液槽(20)に流入する。弁(55a)(55a)を閉じて、弁(50a)を開くと、吸引管(50)を流れる流体は、固体分離手段(55)を経由することなく、貯液槽(20)に流入する。

貯液槽(20)には、弁(26a)を介して真空ポンプ手段(26)が接続されており、該真空ポンプ手段(26)により、貯液槽(20)内部の気体が吸引され、

貯液槽(20)の内部が負圧状態に保持される。

真空ポンプ手段(26)の下流側は、吸引された気体を脱臭する脱臭塔(27)に連繋されており、脱臭塔(27)には、脱臭剤を循環するポンプ(28)が弁(28a)を介して接続されている。真空ポンプ手段(26)から吸引された気体は、脱臭塔(27)を通して無臭化され、外部に放出される。

上述したポンプ手段、弁等はすべて、温度計、圧力計、流量計等の測定値に基づいて、作動、開閉等が行なわれるべく、電氣的に接続されている。

上記洗浄システム(10)は、トラックなどの車輛の荷台に搭載し、洗浄対象となる排水管を有する移動機体の駐機位置まで移動して、排水管の洗浄を行なうことができる。

上記構成の洗浄システム(10)を搭載した車輛(80)を用いて、移動機体(90)の排水管(91)を洗浄する方法について説明する。

貯液槽(20)には、オキシカルボン酸としてL-リンド酸及びクエン酸、スルファミン酸としてアミドスルフォン酸を含み、固形のチップとしてもみがらを混入した洗浄液Lを投入し、プロアー(24)を作動させて、洗浄液Lを攪拌しておく。

洗浄システム(10)を搭載した車輛を移動機体(90)の近傍まで移動させ、移動機体(90)の排水管(91)及び汚水槽(92)に溜まっている汚水を流し出した後、排水管(91)(又は汚水槽(92))に送給管(30)の先端を接続し、排水管(91)の上流側に吸引管(50)の先端を接続する。

配管の接続が完了した後、送給ポンプ手段(32)、真空ポンプ手段(26)及びエアトランスフォーマ(23)を作動させる。

送給ポンプ手段(32)及び真空ポンプ手段(26)の作動により、送給管(30)から洗浄液Lが排水管(91)に供給される。

このとき、戻し弁手段(42)の圧力調整用戻し弁(44)は、流量計(43)(4

3) 及び圧力計(41)の測定値に応じて、開度調整を行なう。

真空ポンプ手段(26)による負圧吸引によって、排水管(91)の内部に洗浄液Lが充満し、洗浄液L中の固形チップにより、付着している有機化合物及び嫌気性バクテリアが徐々に削ぎ落とされる。また、洗浄液L中のオキシカルボン酸及びスルファミン酸により、カルシウム化合物が徐々に溶解する。

洗浄液Lは、排水管(91)から吸引管(50)に流入する。このとき、吸引管(50)には、洗浄液Lと共に排水管(91)の内部の気体が排出される。吸引管(50)から気体と共に洗浄液Lが吸引されると、吸引管(50)の中で気体が気泡となって吸引管(50)を逆流し、流れが悪くなるため、気体分離手段(51)にて、気体成分を分離し、気体は、吸気管(60)から貯液槽(20)に戻す。気体の分離された洗浄液Lは、吸引管(50)から貯液槽(20)に戻る。

旅客航空機の場合、洗浄液Lは、約2～3分で洗浄システム(10)を一周する。この洗浄を約20分ほど続けると、スケール中の有機化合物及び嫌気性バクテリアをほぼ除去できるため、その後は、固形チップが不要となる。そこで、弁(55a)(55a)を開き、弁(50a)を閉じて、固体分離手段(55)で洗浄液L中の固体成分を取り除き、液体成分のみを貯液槽(20)に戻すようにしている。

その後、上記洗浄を1時間程度行なうことにより、排水管(91)内のカルシウム化合物も完全に除去される。排水管(91)内のスケールが完全に除去されると、送給ポンプ手段(32)、真空ポンプ手段(26)を停止し、排水管(91)及び汚水槽(92)に残っている洗浄液Lを取り除いて、洗浄作業が終了する。

洗浄を行なっているときに、圧力計(22)(34)(41)(52)や流量計(33)(43)、温度計(21)等の測定値が設定値を外れると、洗浄システム(10)又は

排水管(91)に異常が発生していることになる。この場合、排水管(91)内が高圧になって、排水管(91)から洗浄液Lが漏れ出すと問題があるため、戻し管(40)の非常用の戻し弁(45)を開き、送給管(30)内の洗浄液Lを戻し管(40)から貯液槽(20)に戻すことにより、排水管(91)に洗浄液Lが流れ込むのを防止して、排水管(91)内が高圧とならないようにする。

また、吸気管(60)の外気導入弁手段(61)を開き、気体流入阻止弁(62)を閉じて、外気導入弁手段(61)から外気を排気管(60)から排水管(91)に導入する。これにより、排気管(91)の内部は大気圧よりも高くなることはない。

#### 産業上の利用可能性

本発明の移動機体内の排水管の洗浄システムは、移動機体から排水管を取り外すことなく、短時間で排水管を洗浄し、スケールを除去できるシステムとして有用である。

## 請 求 の 範 囲

1. 移動機体の内部に配設された排水管を洗浄するシステムであって、  
洗浄液が入れられた貯液槽と、

該貯液槽と移動機体排水管の下流側とを連結し、貯液槽から排水管の下流側に洗浄液を送り込む送給ポンプ手段を具えた送給管と、

排水管の上流側と貯液槽とを連結する吸引管と、

貯液槽内から気体を吸引する真空ポンプ手段とを具えており、

吸引管には、排水管から吸引された気体、液体及び固体の中から、気体を分離する気体分離手段を設け、

気体分離手段と貯液槽との間には、吸引管と並列に接続され、分離された気体を貯液槽に戻す吸気管を配設して構成され、

送給ポンプ手段と真空ポンプ手段を作動し、排水管内を負圧状態に維持しつつ、貯液槽から送給管を通じて排水管内に洗浄液を送り込み、排水管の上流側へ向けて洗浄液を流動させて、排水管中に付着したスケールを取り除き、取り除かれたスケールを洗浄液と共に吸引管から吸引し、気体分離手段にて気体、液体及び固体から気体のみを分離し、液体と固体を吸引管を通じて貯液槽に戻すとともに、気体を吸気管から貯液槽に戻すようにしたことを特徴とする移動機体内の排水管の洗浄システム。

2. 送給ポンプ手段の下流側には、送給管から分岐し、貯液槽に接続される戻し管が配設され、該戻し管には、送給管を通して排水管に送給される洗浄液の圧力をほぼ一定に保持し、洗浄液の圧力が所定値を越えたときに洗浄液の一部又は全部を貯液槽に還流する戻し弁装置が設けられている請求項1に記載の移動機体内の排水管の洗浄システム。
3. 吸気管には、気体分離手段の下流側に外気を導入する外気導入弁手

段と、該外気導入弁手段の下流側に、吸気管を閉じて貯液槽への気体の流入を阻止する気体流入阻止弁手段とを具え、通常運転時には、外気導入弁手段を閉じ、流入阻止弁手段を開き、排水管内部の圧力が所定値を越えたときに、排水管の内部の圧力を調整するために、外気導入弁手段を開くと共に流入阻止弁手段を閉じる請求項 1 又は請求項 2 に記載の移動機体内の排水管の洗浄システム。

4. 吸引管には、気体分離手段と貯液槽との間に、固体を分離する固体分離手段が並列に接続される請求項 1 乃至請求項 3 の何れかに記載の移動機体内の排水管の洗浄システム。

5. 洗浄液には、固形のチップが含まれている請求項 1 乃至請求項 4 の何れかに記載の移動機体内の排水管の洗浄システム。

6. 洗浄液は、オキシカルボン酸を少なくとも一種以上と、スルファミン酸を少なくとも一種以上含んでいる請求項 1 乃至請求項 5 の何れかに記載の移動機体内の排水管の洗浄システム。

7. 請求項 1 乃至請求項 6 の何れかに記載の移動機体内の排水管の洗浄システムを搭載した車輛。

FIG. 1

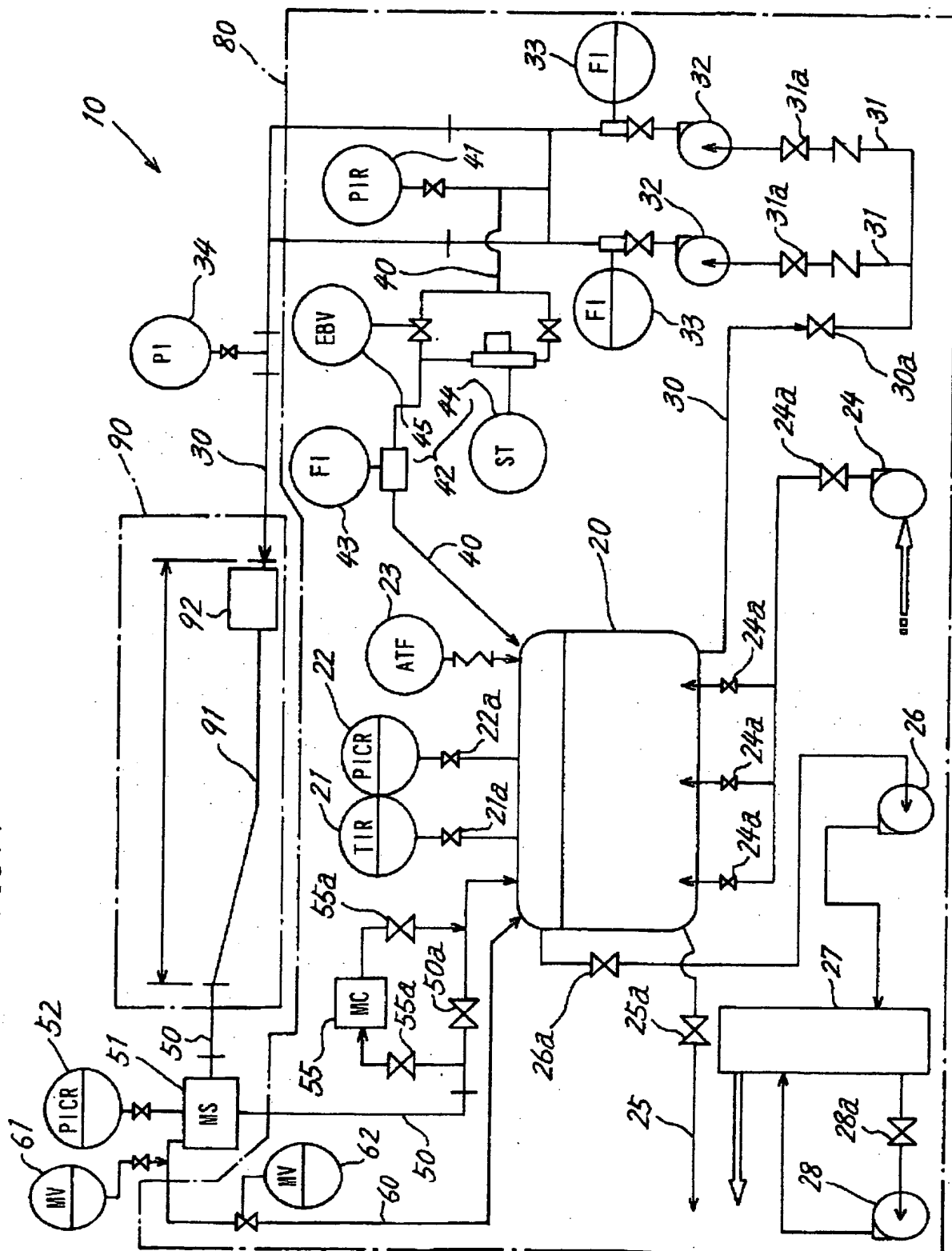
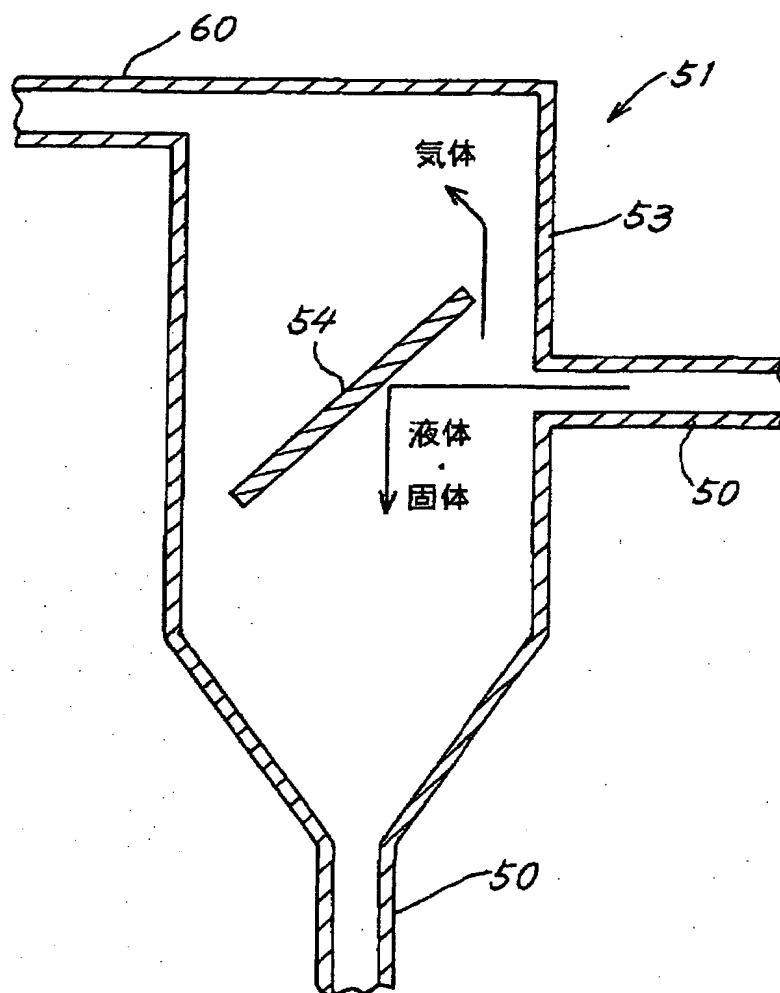




FIG. 2



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/07756

A. CLASSIFICATION OF SUBJECT MATTER  
Int. Cl.<sup>7</sup> B08B 9/027

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
Int. Cl.<sup>7</sup> B08B 9/027

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Jitsuyo Shinan Koho 1940-2001 Toroku Jitsuyo Shinan Koho 1994-2001  
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-285675 A (Japan Steel & Tube Construction Co., Ltd.), 19 October, 1999 (19.10.99) (Family: none)	1, 4, 5-7
A		2-3
Y	JP 6-58435 B2 (Toshiba Corporation), 03 August, 1994 (03.08.94) (Family: none)	1, 4, 5-7
A		2-3
Y	JP 2717627 B2 (Ryobi, Limited), 14 November, 1997 (14.11.97) (Family: none)	5

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

\* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search  
07 December, 2001 (07.12.01)

Date of mailing of the international search report  
18 December, 2001 (18.12.01)

Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

## A. 発明の属する分野の分類 (国際特許分類 (IPC))

Int Cl<sup>7</sup> B08B 9/027

## B. 調査を行った分野

調査を行った最小限資料 (国際特許分類 (IPC))

Int Cl<sup>7</sup> B08B 9/027

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報 1940-2001年

日本国公開実用新案公報 1971-2001年

日本国登録実用新案公報 1994-2001年

日本国実用新案登録公報 1996-2001年

国際調査で使用した電子データベース (データベースの名称、調査に使用した用語)

## C. 関連すると認められる文献

引用文献の カテゴリー*	引用文献名 及び一部の箇所が関連するときは、その関連する箇所の表示	関連する 請求の範囲の番号
Y A	JP 11-285675 A (日本鋼管工事株式会社) 19. 10月. 1999 (19. 10. 99) (ファミリーなし)	1, 4, 5-7 2-3
Y A	JP 6-58435 B2 (株式会社 東芝) 3. 8月. 1994 (03. 08. 94) (ファミリーなし)	1, 4, 5-7 2-3
Y	JP 2717627 B2 (リョービ株式会社) 14. 11月. 1997 (14. 11. 97) (ファミリーなし)	5

☐ C欄の続きにも文献が列举されている。☐ パテントファミリーに関する別紙を参照。

## \* 引用文献のカテゴリー

「A」特に関連のある文献ではなく、一般的技術水準を示すもの

「E」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの

「L」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献 (理由を付す)

「O」口頭による開示、使用、展示等に関する文献

「P」国際出願日前で、かつ優先権の主張の基礎となる出願

の日の後に公表された文献

「T」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの

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「Y」特に関連のある文献であって、当該文献と他の1以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの

「&amp;」同一パテントファミリー文献

国際調査を完了した日

07. 12. 01

国際調査報告の発送日

18.12.01

国際調査機関の名称及びあて先

日本国特許庁 (ISA/JP)

郵便番号100-8915

東京都千代田区霞が関三丁目4番3号

特許庁審査官 (権限のある職員)

増 澤 誠

印

3K 7535

電話番号 03-3581-1101 内線 3332



US 20030172963A1

(19) **United States**(12) **Patent Application Publication**  
**Sugimoto**(10) **Pub. No.: US 2003/0172963 A1**(43) **Pub. Date: Sep. 18, 2003**(54) **SYSTEM FOR CLEANING DRAINAGE PIPES  
IN MOVABLE EQUIPMENT**(76) **Inventor: Takeshi Sugimoto, Habikino-shi (JP)**

Correspondence Address:

**ARMSTRONG, WESTERMAN & HATTORI,  
LLP****1725 K STREET, NW****SUITE 1000****WASHINGTON, DC 20006 (US)**(21) **Appl. No.: 10/220,287**(22) **PCT Filed: Sep. 6, 2001**(86) **PCT No.: PCT/JP01/07756****Publication Classification**(51) **Int. Cl.<sup>7</sup> ..... B08B 3/00; B08B 9/00**(52) **U.S. Cl. .... 134/168 R**(57) **ABSTRACT**

A system is provided which is capable of cleaning a drainage pipe in a short time for removal of scale without detaching the drainage pipe from movable equipment. The system comprises: a reservoir tank containing a cleaning liquid; a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank; a suction pipe connecting an upstream side of the drainage pipe and the reservoir tank; and vacuum pump means for sucking gas from the reservoir tank; wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe; wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank.

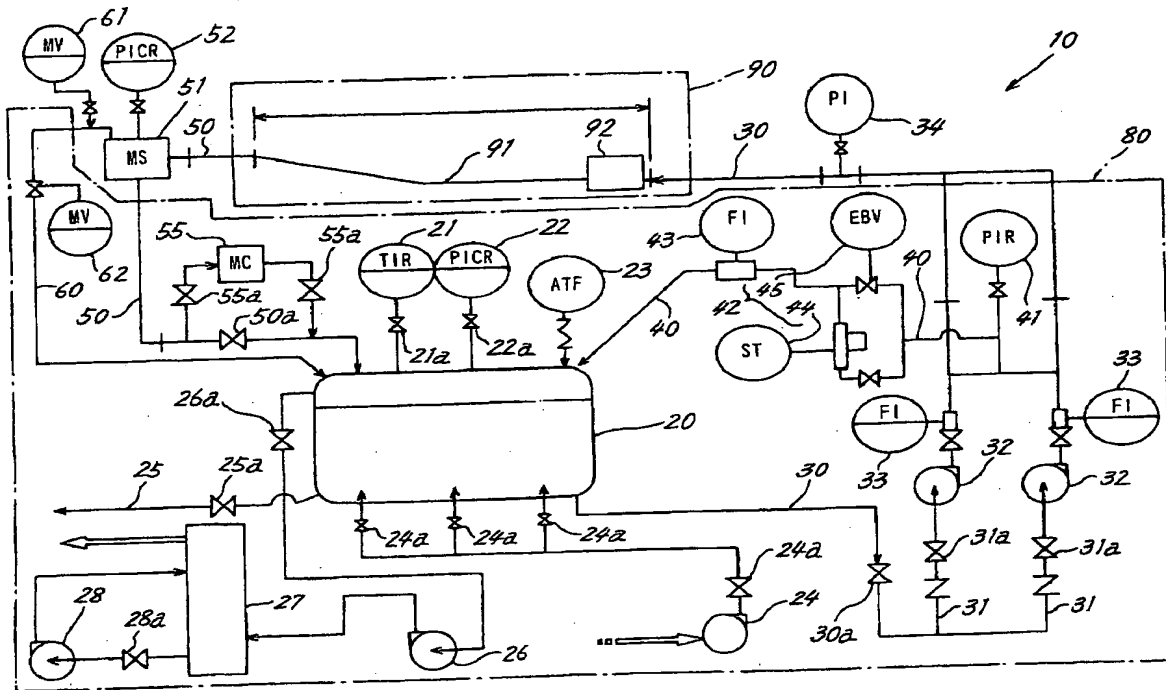


FIG. 1

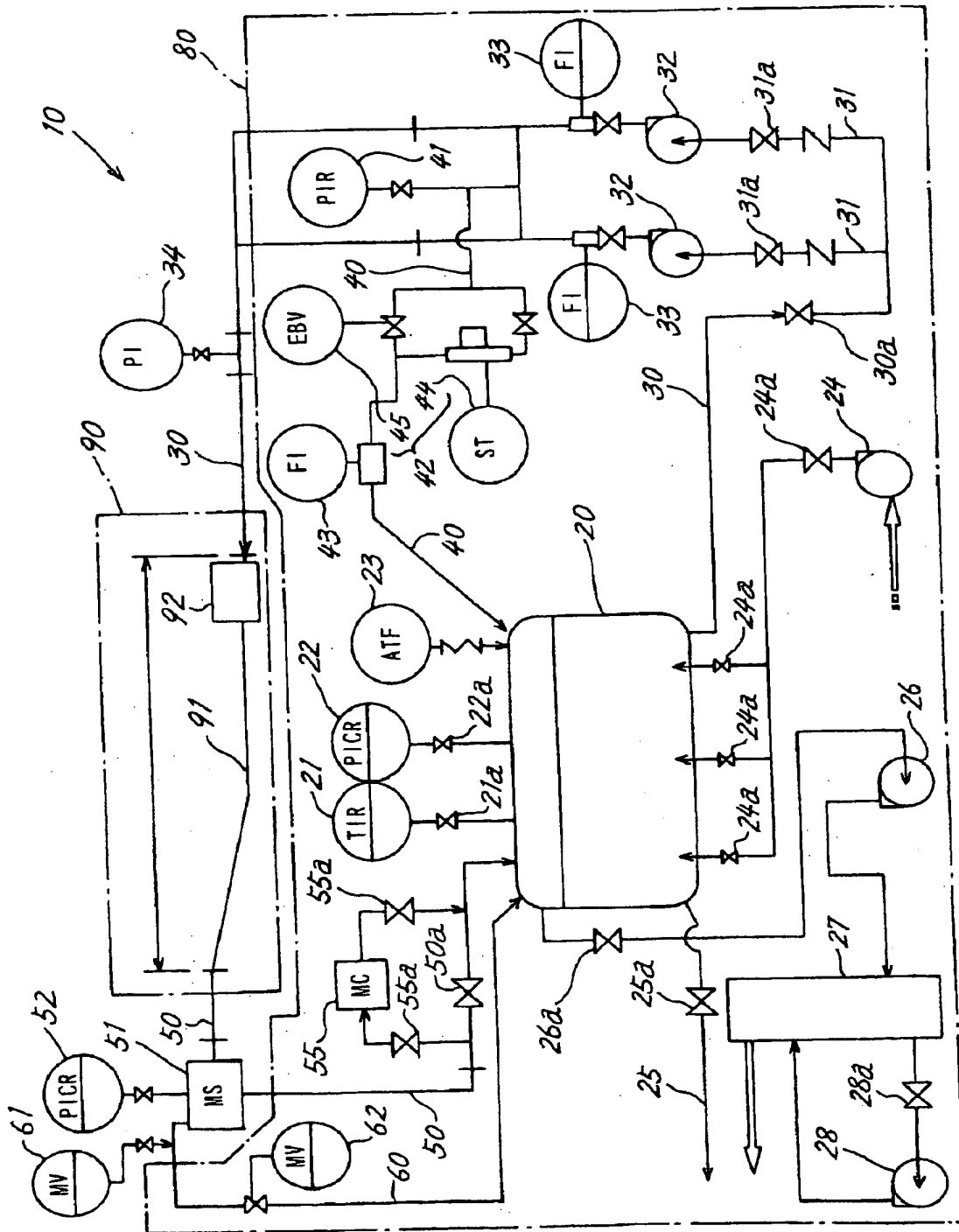
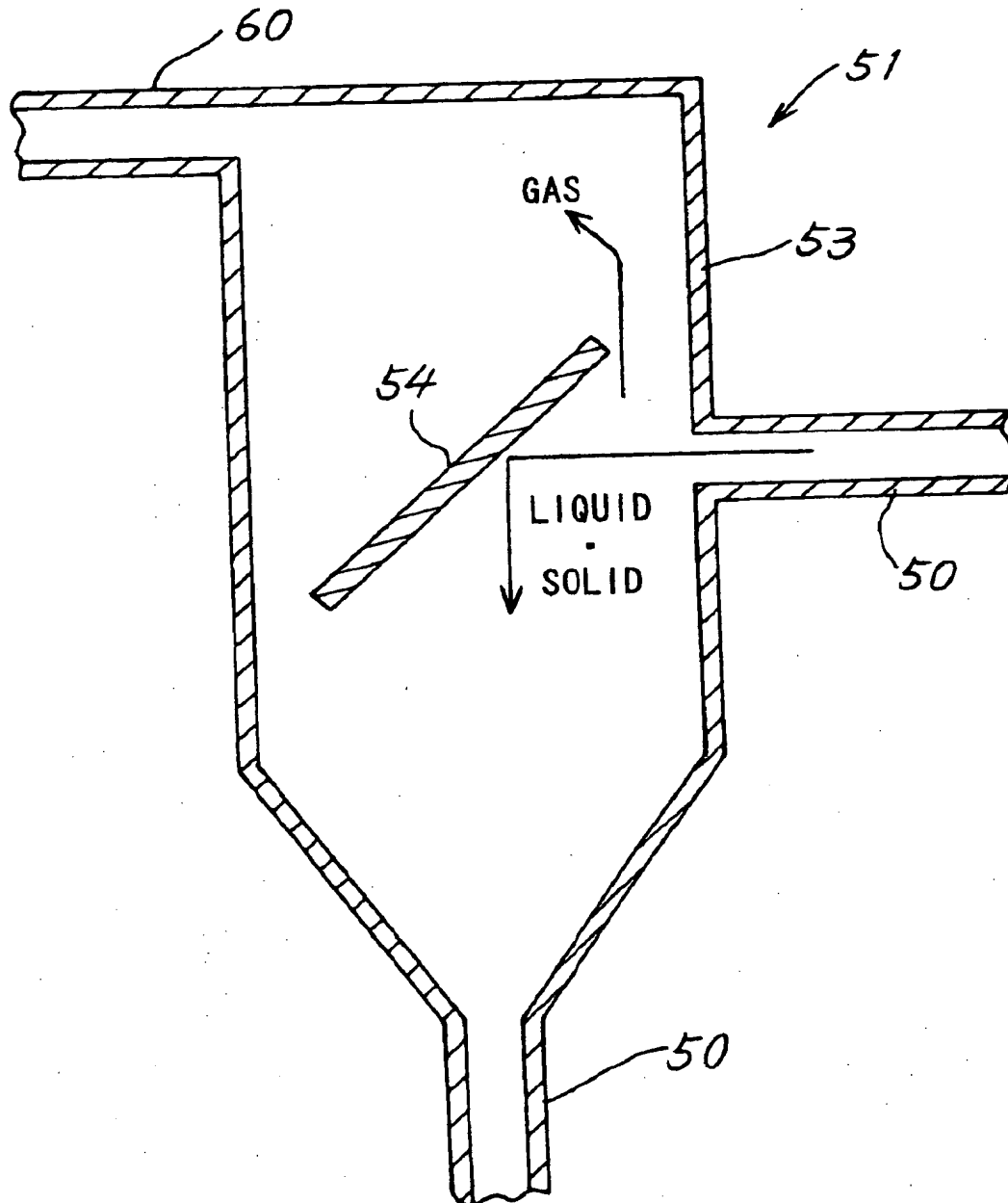


FIG. 2



## SYSTEM FOR CLEANING DRAINAGE PIPES IN MOVABLE EQUIPMENT

### TECHNICAL FIELD

[0001] The present invention relates to a system for cleaning a pipe provided in movable equipment such as a passenger plane and, more specifically, to a system for removing scale deposited within drainage pipes of a sink and a toilet in a lavatory.

### BACKGROUND ART

[0002] In movable equipments such as passenger planes, drainage pipes are installed for a sink and a toilet in a lavatory. During use of the drainage pipes, calcium compounds and organic compounds are deposited in the drainage pipes (the deposit is hereinafter referred to as "scale"). Since the scale thus deposited may cause the reduction of the draining capacity, the clogging of the pipes and an offensive smell, the scale should periodically be removed.

[0003] A conventional method for the removal of the scale is such that the drainage pipes are detached from the movable equipment, transported to a site equipped with a special cleaning apparatus for cleaning the drainage pipes, transported back to the movable equipment after completion of the cleaning, and attached to the movable equipment.

[0004] The movable equipment has a complicated inner structure, and the drainage pipes are bent in various directions. Therefore, the drainage pipe detaching and attaching operations are very difficult, requiring enormous amounts of time, efforts and costs. For this reason, a drainage pipe cleaning operation is performed only in a regular maintenance operation. Since the scale is gradually deposited in the drainage pipes, reduction in draining capacity and sudden clogging of the drainage pipes may occur before the next regular maintenance operation.

[0005] Accordingly, there is a great demand for development of a system for cleaning a drainage pipe in a short time without detaching the drainage pipe.

[0006] It is an object of the present invention to provide a system for cleaning a drainage pipe in a short time for removal of scale without detaching the drainage pipe from movable equipment.

### DISCLOSURE OF THE INVENTION

[0007] To solve the aforesaid problem, a system for cleaning a drainage pipe in a movable equipment in accordance with the present invention comprises: a reservoir tank containing a cleaning liquid; a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank; a suction pipe connecting an upstream side of the drainage pipe and the reservoir tank; and vacuum pump means for sucking gas from the reservoir tank; wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe; wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank.

[0008] In the system for cleaning the drainage pipe in the movable equipment, the feed pump means and the vacuum pump means are actuated to maintain the inside of the drainage pipe at a negative pressure, to feed the cleaning liquid into the drainage pipe from the reservoir tank through the feed pipe, and to cause the cleaning liquid to flow toward the upstream side of the drainage pipe, whereby scale deposited in the drainage pipe is removed and the removed scale is sucked together with the cleaning liquid through the suction pipe. After only the gas is separated from the gas, the liquid and the solid sucked into the suction pipe by the gas separation means, the liquid and the solid are fed back into the reservoir tank through the suction pipe, and the gas is fed back into the reservoir tank through the gas suction pipe.

[0009] Since the inside of the drainage pipe is maintained at a negative pressure, the cleaning liquid and the like do not leak out of the drainage pipe. Further, the cleaning liquid is caused to flow in a direction opposite to a normal water draining direction in the drainage pipe, i.e., from the downstream side to the upstream side of the drainage pipe. Thus, energy is applied to the scale in a direction opposite to a scale growing direction so as to promote the removal of the scale. Therefore, scale removing and cleaning effects can be enhanced.

[0010] Since the gas is separated from the liquid and the solid in the suction pipe by the gas separation means, the gas does not flow back in the form of bubbles nor hinder the flow of the liquid and the solid in the suction pipe.

[0011] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention may further comprise a feed-back pipe diverged from the feed pipe on a downstream side of the feed pump means and connected to the reservoir tank, wherein the feed-back pipe is provided with a feed-back valve device for maintaining a pressure of the cleaning liquid fed into the drainage pipe through the feed pipe at a substantially constant level and, when the pressure of the cleaning liquid exceeds a predetermined level, feeding a part or all of the cleaning liquid back into the reservoir tank.

[0012] According to the system for cleaning the drainage pipe in the movable equipment, the feed-back valve device is opened to feed the part or all of the cleaning liquid back into the reservoir tank from the feed-back pipe when the pressure of the cleaning liquid fed into the drainage pipe from the feed pipe exceeds the predetermined level. Therefore, the cleaning liquid does not flow into the drainage pipe at a pressure greater than the predetermined level.

[0013] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention preferably further comprises outside air introduction valve means provided in the gas suction pipe for introducing outside air to a downstream side of the gas separation means, and gas introduction preventing valve means provided on a downstream side of the outside air introduction valve means for closing the gas suction pipe for prevention of introduction of the gas into the reservoir tank, wherein the outside air introduction valve means is closed and the introduction preventing valve means is opened during a normal operation and, when an inner pressure of the drainage pipe exceeds a predetermined level, the outside air introduction valve means is opened and the introduction preventing valve means is closed for adjustment of the inner pressure of the drainage pipe.

[0014] According to the system for cleaning the drainage pipe in the movable equipment, the outside air introduction valve means is opened and the introduction preventing valve means is closed when the inner pressure of the drainage pipe exceeds the predetermined level due to bad flow of the cleaning liquid in the drainage pipe or clogging of the drainage pipe. Thus, the outside air sucked through the outside air introduction valve means is introduced into the drainage pipe without flowing into the reservoir tank from the gas suction pipe. Therefore, the inner pressure of the drainage pipe is maintained at the atmospheric pressure, so that the cleaning liquid and the like do not scatter out of the drainage pipe.

[0015] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, solid separation means for separating the solid is preferably connected parallel to the suction pipe between the gas separation means and the reservoir tank.

[0016] Since the system for cleaning the drainage pipe in the movable equipment includes the solid separation means, the solid component is separated from the cleaning liquid as required during the cleaning and only the liquid component is fed back into the reservoir tank.

[0017] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, the cleaning liquid preferably contains solid chips.

[0018] When the solid chips contained in the cleaning liquid bump against organic compounds and the like in the scale, the organic compounds and anaerobic bacteria in the drainage pipe can be removed.

[0019] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, the cleaning liquid preferably contains at least one oxycarboxylic acid and at least one sulfamic acid.

[0020] The cleaning liquid containing the at least one oxycarboxylic acid and the at least one sulfamic acid is particularly advantageous for dissolving calcium compounds in the scale for removal thereof.

[0021] A vehicle according to the present invention is mounted with the aforesaid system for cleaning the drainage pipe in the movable equipment.

[0022] Since the system for cleaning the drainage pipe in the movable equipment is mounted on the vehicle, the vehicle is moved to a site where the movable equipment is parked for cleaning the drainage pipe. This obviates the need for moving the movable equipment to a predetermined site for cleaning the drainage pipe of the movable equipment.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is an explanatory diagram illustrating the construction of a cleaning system according to the present invention; and

[0024] FIG. 2 is a sectional view of gas separation means.

#### BEST MODE FOR CARRYING OUT THE INVENTION

[0025] Examples of the movable equipment in which the drainage pipe to be cleaned is installed include passenger planes, rail-road coaches, buses and ships.

[0026] As shown in FIG. 1, a drainage pipe 91 is installed in movable equipment 90. The drainage pipe 91 includes a plurality of drainage pipes each having an upstream end connected to a sink or a toilet in a lavatory, and a downstream end connected to a common sewage tank 92.

[0027] FIG. 1 illustrates the overall construction of a cleaning system 10. As shown, the cleaning system 10 is constructed so that a reservoir tank 20 containing a cleaning liquid L is connected to the drainage pipe 91 of the movable equipment 90 by a feed pipe 30 and a suction pipe 50.

[0028] The reservoir tank 20 may be mounted on a vehicle 80 such as a truck. The feed pipe 30 for feeding the cleaning liquid L into the drainage pipe 91 of the movable equipment 90 is connected to the reservoir tank 20 at a position lower than the surface level of the cleaning liquid L. A feed-back pipe 40 to be described later, the suction pipe 50, and a gas suction pipe 60 are connected to the reservoir tank 20 at positions upper than the surface level of the cleaning liquid L. Further, the reservoir tank 20 is provided with a thermometer 21 and a pressure gauge 22 for measuring the inner temperature and pressure of the reservoir tank with the intervention of valves 21a and 22a, respectively. The reservoir tank 20 is further connected to an air transformer 23 for supplying outside air into the reservoir tank when a toxic gas or a combustible gas is generated by the cleaning. The reservoir tank 20 is further connected to a blower 24 for agitating the cleaning liquid L in the reservoir tank 20 and to a blow down pipe 25 for draining the cleaning agent L from the dissolution tank via valves 24a and 25a, respectively.

[0029] The cleaning liquid L to be contained in the reservoir tank 20 may properly be selected depending on the components and amount of the scale deposited in the drainage pipe 91 of the movable equipment 90 and the configuration of the drainage pipe 91. In the case of a passenger plane, for example, the scale deposited in the drainage pipe is mainly composed of calcium compounds, organic compounds and anaerobic bacteria. For removal of the calcium compounds in the scale, a cleaning liquid containing at least one oxycarboxylic acid and at least one sulfamic acid is preferably employed. The organic compounds and the anaerobic bacteria are often deposited in a slime form on the calcium compounds. Therefore, solid chips are mixed in the cleaning liquid L for scraping away the deposited organic compounds and the like. Examples of the solid chips mixed in the cleaning liquid include rice husks and silicone granules.

[0030] The feed pipe 30 for feeding the cleaning liquid L into the drainage pipe 91 is connected to a downstream side of the drainage pipe 91 of the movable equipment 90. The feed pipe 30 may be connected to the sewage tank 92 of the movable equipment 90 as shown in the figure.

[0031] The feed pipe 30 is branched into two branch feed pipes 31, 31 downstream of a valve 30a, and the branch feed pipes 31, 31 are respectively provided with feed pump means 32, 32 with the intervention of valves 31a, 31a. Flow meters 33, 33 are provided downstream of the feed pump means 32, 32 for monitoring the flow rates of the cleaning liquid L fed into the drainage pipe 91 from the feed pump means 32, 32. Since the feed pipe 30 is branched and the two feed pump means 32, 32 are provided, the pump head capacity of each of the feed pump means can be reduced and



the supply amount can be stabilized. Even if one of the pump means is broken, the cleaning liquid L can be fed by driving the other pump means.

[0032] The feed-back pipe 40 is connected to the branch feed pipes 31, 31 downstream of the flow meters 33, 33. The feed-back pipe 40 will be described later.

[0033] The branch feed pipes 32, 32 join together downstream of a branch point at which the feed-back pipe 40 is diverged therefrom. An end of the joined feed pipe 30 is connected to the drainage pipe 91 of the movable equipment 90 via a pressure indicator 34.

[0034] The feed-back pipe 40 is a pipe for feeding a part or all of the cleaning liquid L back into the reservoir tank 20 from the branch feed pipes 31, 31. The feed-back pipe 40 is branched into two branches and joined together. A pressure gauge 41 is provided upstream of a branch point, and feed-back valve means 42 is provided in the branches. A flow meter 43 is provided downstream of a junction of the branches.

[0035] The feed-back valve means 42 includes a solution pressure adjustment feed-back valve 44 provided in one of the branches and an emergency feed-back valve 45 provided in the other branch. The solution pressure adjustment feed-back valve 44 feeds apart of the cleaning liquid L flowing through the branch feed pipes 31, 31 into the reservoir tank 20 according to measurements taken by the pressure gauge 41 and the flow meters 33, 33 provided in the feed pipe 30, thereby serving to maintain the pressure and flow rate of the cleaning liquid L fed into the drainage pipe 91 from the feed pipe 30 at constant levels. The emergency feed-back valve 45 is opened to prevent the cleaning liquid L from flowing into the drainage pipe 91 from the feed pipe 30 when any of the pressure gauges provided in the cleaning system 10 indicates a pressure higher than a predetermined level.

[0036] One end of the suction pipe 50 is connected to an upstream side of the drainage pipe 91 of the movable equipment 90, i.e., to the side of the sink and the toilet, and the other end of the suction pipe 50 is connected to the reservoir tank 20.

[0037] The cleaning liquid L discharged from the drainage pipe 91, the scale and a gas component in the drainage pipe and the like are sucked as fluid effluent through the suction pipe 50.

[0038] Gas separation means 51 is provided in the suction pipe 50, whereby the gas component is separated from the effluent and fed back into the reservoir tank 20 through the gas suction pipe 60, and the liquid and solid components are fed back into the reservoir tank 20 through the suction pipe 50. The gas separation means 51 is provided with a measurement instrument 52 for detecting, adjusting and recording a pressure.

[0039] For example, a device which includes a cylindrical vessel 53 having a smaller-diameter lower end and a baffle plate 54 provided diagonally downward in a generally central portion of the vessel 53 as shown in FIG. 2 may be employed as the gas separation means 51. In this device, the effluent sucked from the drainage pipe 91 of the movable equipment 90 is thrown against the baffle plate 54, whereby the gas component flows upward and the liquid and solid components flow downward by gravity for separation of the

gas component from the liquid and solid components. The separated gas component is fed back into the reservoir tank 20 through the gas suction pipe 60 connected to an upper portion of the vessel 53. The liquid and solid components are fed back into the reservoir tank 20 through the suction pipe 50 connected to a lower end of the cylindrical vessel 53.

[0040] Outside air introduction valve means 61 and gas introduction preventing valve means 62 are provided in this order downstream of the gas separation means 51 in the gas suction pipe 60. These valve means 61, 62 introduce the outside air into the drainage pipe 91 to restore the inner pressure of the drainage pipe 91 to the atmospheric pressure when the inner pressure of the drainage pipe 91 exceeds a predetermined level, whereby the inner pressure of the drainage pipe 91 is prevented from increasing to a high level. The outside air introduction valve means 61 is a valve for introducing the outside air into the drainage pipe 91 through the suction pipe 50 from the gas suction pipe 60. This valve is closed during a normal operation, and is opened when the pressure in the drainage pipe 91 exceeds the predetermined level. On the other hand, the gas introduction preventing valve 62 closes the gas suction pipe 60 so as to allow the outside air introduced from the outside air introduction valve means 61 to flow into the drainage pipe 91 without flowing into the reservoir tank 20 from the gas suction pipe 60 when the outside air introduction valve means 61 is opened, and is opened during the normal operation.

[0041] In the suction pipe 50, a valve 50a is provided downstream of the gas separation means 51, and solid separation means 55 is provided parallel to the valve 50a.

[0042] The solid separation means 55 separates the solid component from the liquid and solid components separated by the gas separation means 51, and only the liquid component is fed back into the suction pipe 50. Valves 55a, 55a are respectively provided on upstream and downstream sides of the solid separation means 55. A filter, for example, may be employed as the solid separation means 55.

[0043] When the valves 55a, 55a are opened and the valve 50a is closed, the fluid flowing through the suction pipe 50 flows into the solid separation means 55 and, after the solid component is separated, only the liquid component flows into the reservoir tank 20. When the valves 55a, 55a are closed and the valve 50a is opened, the fluid flowing through the suction pipe 50 is introduced into the reservoir tank 20 without flowing through the solid separation means 55.

[0044] Vacuum pump means 26 is connected to the reservoir tank 20 via a valve 26a. The vacuum pump means 26 sucks gas from the reservoir tank 20 to maintain the inside of the reservoir tank 20 at a negative pressure.

[0045] A deodorization tower 27 for deodorizing the sucked gas is connected to a downstream side of the vacuum pump means 26. A pump 28 for circulating a deodorant is connected to the deodorization tower 27 via a valve 28a. The gas sucked from the vacuum pump means 26 passes through the deodorization tower 27 thereby to be deodorized, and emitted to the outside.

[0046] The pump means, the valves and the like described above are electrically connected to each other for actuation thereof or opening and closing thereof on the basis of measurements taken by the thermometers, the pressure gauges and the flow meters.

[0047] The cleaning system 10 is mounted on a deck of a vehicle such as a truck, and transported to a site where the movable equipment having the drainage pipe to be cleaned is parked for cleaning the drainage pipe.

[0048] An explanation will be given to how to clean the drainage pipe 91 of the movable equipment 90 by utilizing the vehicle 80 mounted with the cleaning system 10 having the aforesaid construction.

[0049] A cleaning liquid L containing L-malic acid and citric acid as the oxycarboxylic acid and amidosulfonic acid as the sulfamic acid and containing rice husks as the solid chips is filled into the reservoir tank 20, and the blower 24 is actuated to agitate the cleaning liquid L.

[0050] The vehicle mounted with the cleaning system 10 is moved to the vicinity of the movable equipment 90. After sewage accumulated in the drainage pipe 91 and the sewage tank 92 of the movable equipment is discharged, an end of the feed pipe 30 is connected to the drainage pipe 91 (or the sewage tank 92), and an end of the suction pipe 50 is connected to the upstream end of the drainage pipe 91.

[0051] After completion of the pipe connection, the feed pump means 32, the vacuum pump means 26 and the air transformer 23 are actuated.

[0052] By the actuation of the feed pump means 32 and the vacuum pump means 26, the cleaning liquid L is fed into the drainage pipe 91 from the feed pipe 30.

[0053] At this time, the pressure adjustment feed-back valve 44 of the feed-back valve means 42 adjusts a ratio of valve opening according to measurements taken by the flow meters 43, 43 and the pressure gauge 41.

[0054] The drainage pipe 91 is filled with the cleaning liquid L by suction to a negative pressure by the vacuum pump means 26. Thus, deposited organic compounds and anaerobic bacteria are gradually scraped away by the solid chips in the cleaning liquid L. Further, calcium compounds are gradually dissolved by the oxycarboxylic acid and the sulfamic acid in the cleaning liquid L.

[0055] The cleaning liquid L flows into the suction pipe 50 from the drainage pipe 91. At this time, gas in the drainage pipe 91 is discharged together with the cleaning liquid L into the suction pipe 50. When the cleaning liquid L is sucked together with the gas from the suction pipe 50, the gas is liable to flow back in the form of bubbles through the suction pipe 50, resulting in bad flow. Therefore, the gas component is separated by the gas separation means 51, and fed back into the reservoir tank 20 through the gas suction pipe 60. The cleaning liquid L from which the gas is separated is fed back into the reservoir tank 20 through the suction pipe 50.

[0056] In the case of the passenger plane, the cleaning liquid L flows around the cleaning system 10 in about two to three minutes. Since the organic compounds and the anaerobic bacteria in the scale are mostly removed by continuing the cleaning for about 20 minutes, the solid chips are thereafter unnecessary. Therefore, the valves 55a, 55a are opened and the valve 50a is closed to remove the solid component from the cleaning liquid L by the solid separation means 55. Thus, only the liquid component is fed back into the reservoir tank 20.

[0057] Thereafter, the cleaning is continued for about one hour, whereby the calcium compounds in the drainage pipe

91 are completely removed. After the scale in the drainage pipe 91 is completely removed, the feed pump means 32 and the vacuum pump means 26 are stopped, and the cleaning liquid L remaining in the drainage pipe 91 and the sewage tank 92 are removed. Thus, the cleaning operation is completed.

[0058] When measurements taken by the pressure gauges 22, 34, 41, 52, the flow meters 33, 43 and the thermometer 21 are out of the predetermined levels during the cleaning, an abnormality occurs in the cleaning system 10 or the drainage pipe 91. In such a case, the inner pressure of the drainage pipe 91 increases to a high level, resulting in leakage of the cleaning liquid L from the drainage pipe 91. Therefore, the emergency feed-back valve 45 of the feed-back pipe 40 is opened, whereby the cleaning liquid L in the feed pipe 30 is fed back into the reservoir tank 20 through the feed-back pipe 40. Thus, the cleaning liquid L is prevented from flowing into the drainage pipe 91 to prevent the inner pressure of the drainage pipe 91 from increasing to a high level.

[0059] Further, the outside air introduction valve means 61 of the gas suction pipe 60 is opened and the gas introduction preventing valve 62 is closed to introduce the outside air into the drainage pipe 91 from the outside air introduction valve means 61 through the gas discharge pipe 60. Thus, the inner pressure of the gas discharge pipe 91 is not increased higher than the atmospheric pressure.

[0060] Industrial Applicability

[0061] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention is useful as a system which is capable of cleaning the drainage pipe in a short time for removal of the scale without detaching the drainage pipe from the movable equipment.

What is claimed is:

1. A system for cleaning a drainage pipe provided in movable equipment comprising:

a reservoir tank containing a cleaning liquid;

a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank;

a suction pipe connecting an upstream side of the drainage pipe and the reservoir tank; and

vacuum pump means for sucking gas from the reservoir tank;

wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe;

wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank;

wherein the feed pump means and the vacuum pump means are actuated to maintain the inside of the drainage pipe at a negative pressure, to feed the cleaning liquid into the drainage pipe from the reservoir tank through the feed pipe, and to cause the cleaning liquid

to flow toward the upstream side of the drainage pipe, whereby scale deposited in the drainage pipe is removed and the removed scale is sucked together with the cleaning liquid through the suction pipe and, after only the gas is separated from the gas, the liquid and the solid by the gas separation means, the liquid and the solid are fed back into the reservoir tank through the suction pipe, and the gas is fed back into the reservoir tank through the gas suction pipe.

2. The system for cleaning the drainage pipe in the movable equipment according to claim 1, further comprising:

a feed-back pipe diverged from the feed pipe on a downstream side of the feed pump means and connected to the reservoir tank;

wherein the feed-back pipe is provided with a feed-back valve device for maintaining a pressure of the cleaning liquid fed into the drainage pipe through the feed pipe at a substantially constant level and, when the pressure of the cleaning liquid exceeds a predetermined level, feeding a part or all of the cleaning liquid back into the reservoir tank.

3. The system for cleaning the drainage pipe in the movable equipment according to claim 1 or 2, further comprising:

outside air introduction valve means provided in the gas suction pipe for introducing outside air to a downstream side of the gas separation means; and

gas introduction preventing valve means provided on a downstream side of the outside air introduction valve means for closing the gas suction pipe for prevention of introduction of the gas into the reservoir tank;

wherein the outside air introduction valve means is closed and the introduction preventing valve means is opened during a normal operation and, when an inner pressure of the drainage pipe exceeds a predetermined level, the outside air introduction valve means is opened and the introduction preventing valve means is closed for adjustment of the inner pressure of the drainage pipe.

4. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 3, wherein solid separation means for separating the solid is connected parallel to the suction pipe between the gas separation means and the reservoir tank.

5. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 4, wherein the cleaning liquid contains solid chips.

6. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 5, wherein the cleaning liquid contains at least one oxycarboxylic acid and at least one sulfamic acid.

7. A vehicle mounted with the system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 6.

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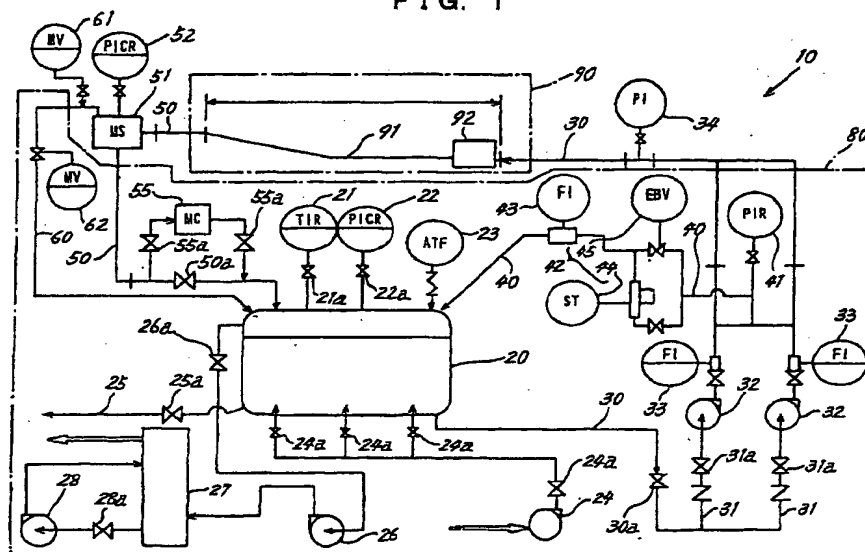
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**AL LT LV MK RO SI**(72) Inventor: **SUGIMOTO, Takeshi****Habikino-shi, Osaka 583-0871 (JP)**(74) Representative: **Skuhra, Udo, Dipl.-Ing. et al****Reinhard-Skuhra-Weise & Partner****Patentanwälte****Postfach 44 01 51****80750 München (DE)**(71) Applicant: **Seiwa Pro Co., Ltd.****Matsubara-shi, Osaka 580-0045 (JP)****(54) WASHING SYSTEM FOR DRAIN PIPE INSIDE MOBILE FRAME**

(57) A system is provided which is capable of cleaning a drainage pipe in a short time for removal of scale without detaching the drainage pipe from movable equipment. The system comprises: a reservoir tank containing a cleaning liquid; a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank; a suc-

tion pipe connecting an upstream side of the drainage pipe and the reservoir tank; and vacuum pump means for sucking gas from the reservoir tank; wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe; wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank.

**FIG. 1****EP 1 336 436 A1**

## Description

### TECHNICAL FIELD

[0001] The present invention relates to a system for cleaning a pipe provided in movable equipment such as a passenger plane and, more specifically, to a system for removing scale deposited within drainage pipes of a sink and a toilet in a lavatory.

### BACKGROUND ART

[0002] In movable equipments such as passenger planes, drainage pipes are installed for a sink and a toilet in a lavatory. During use of the drainage pipes, calcium compounds and organic compounds are deposited in the drainage pipes (the deposit is hereinafter referred to as "scale"). Since the scale thus deposited may cause the reduction of the draining capacity, the clogging of the pipes and an offensive smell, the scale should periodically be removed.

[0003] A conventional method for the removal of the scale is such that the drainage pipes are detached from the movable equipment, transported to a site equipped with a special cleaning apparatus for cleaning the drainage pipes, transported back to the movable equipment after completion of the cleaning, and attached to the movable equipment.

[0004] The movable equipment has a complicated inner structure, and the drainage pipes are bent in various directions. Therefore, the drainage pipe detaching and attaching operations are very difficult, requiring enormous amounts of time, efforts and costs. For this reason, a drainage pipe cleaning operation is performed only in a regular maintenance operation. Since the scale is gradually deposited in the drainage pipes, reduction in draining capacity and sudden clogging of the drainage pipes may occur before the next regular maintenance operation.

[0005] Accordingly, there is a great demand for development of a system for cleaning a drainage pipe in a short time without detaching the drainage pipe.

[0006] It is an object of the present invention to provide a system for cleaning a drainage pipe in a short time for removal of scale without detaching the drainage pipe from movable equipment.

### DISCLOSURE OF THE INVENTION

[0007] To solve the aforesaid problem, a system for cleaning a drainage pipe in a movable equipment in accordance with the present invention comprises: a reservoir tank containing a cleaning liquid; a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank; a suction pipe connecting an upstream side of the

drainage pipe and the reservoir tank; and vacuum pump means for sucking gas from the reservoir tank; wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe; wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank.

[0008] In the system for cleaning the drainage pipe in the movable equipment, the feed pump means and the vacuum pump means are actuated to maintain the inside of the drainage pipe at a negative pressure, to feed the cleaning liquid into the drainage pipe from the reservoir tank through the feed pipe, and to cause the cleaning liquid to flow toward the upstream side of the drainage pipe, whereby scale deposited in the drainage pipe is removed and the removed scale is sucked together with the cleaning liquid through the suction pipe. After only the gas is separated from the gas, the liquid and the solid sucked into the suction pipe by the gas separation means, the liquid and the solid are fed back into the reservoir tank through the suction pipe, and the gas is fed back into the reservoir tank through the gas suction pipe.

[0009] Since the inside of the drainage pipe is maintained at a negative pressure, the cleaning liquid and the like do not leak out of the drainage pipe. Further, the cleaning liquid is caused to flow in a direction opposite to a normal water draining direction in the drainage pipe, i.e., from the downstream side to the upstream side of the drainage pipe. Thus, energy is applied to the scale in a direction opposite to a scale growing direction so as to promote the removal of the scale. Therefore, scale removing and cleaning effects can be enhanced.

[0010] Since the gas is separated from the liquid and the solid in the suction pipe by the gas separation means, the gas does not flow back in the form of bubbles nor hinder the flow of the liquid and the solid in the suction pipe.

[0011] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention may further comprise a feed-back pipe diverged from the feed pipe on a downstream side of the feed pump means and connected to the reservoir tank, wherein the feed-back pipe is provided with a feed-back valve device for maintaining a pressure of the cleaning liquid fed into the drainage pipe through the feed pipe at a substantially constant level and, when the pressure of the cleaning liquid exceeds a predetermined level, feeding a part or all of the cleaning liquid back into the reservoir tank.

[0012] According to the system for cleaning the drainage pipe in the movable equipment, the feed-back valve device is opened to feed the part or all of the cleaning liquid back into the reservoir tank from the feed-back pipe when the pressure of the cleaning liquid fed into the drainage pipe from the feed pipe exceeds the predetermined level. Therefore, the cleaning liquid does not

flow into the drainage pipe at a pressure greater than the predetermined level.

[0013] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention preferably further comprises outside air introduction valve means provided in the gas suction pipe for introducing outside air to a downstream side of the gas separation means, and gas introduction preventing valve means provided on a downstream side of the outside air introduction valve means for closing the gas suction pipe for prevention of introduction of the gas into the reservoir tank, wherein the outside air introduction valve means is closed and the introduction preventing valve means is opened during a normal operation and, when an inner pressure of the drainage pipe exceeds a predetermined level, the outside air introduction valve means is opened and the introduction preventing valve means is closed for adjustment of the inner pressure of the drainage pipe.

[0014] According to the system for cleaning the drainage pipe in the movable equipment, the outside air introduction valve means is opened and the introduction preventing valve means is closed when the inner pressure of the drainage pipe exceeds the predetermined level due to bad flow of the cleaning liquid in the drainage pipe or clogging of the drainage pipe. Thus, the outside air sucked through the outside air introduction valve means is introduced into the drainage pipe without flowing into the reservoir tank from the gas suction pipe. Therefore, the inner pressure of the drainage pipe is maintained at the atmospheric pressure, so that the cleaning liquid and the like do not scatter out of the drainage pipe.

[0015] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, solid separation means for separating the solid is preferably connected parallel to the suction pipe between the gas separation means and the reservoir tank.

[0016] Since the system for cleaning the drainage pipe in the movable equipment includes the solid separation means, the solid component is separated from the cleaning liquid as required during the cleaning and only the liquid component is fed back into the reservoir tank.

[0017] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, the cleaning liquid preferably contains solid chips.

[0018] When the solid chips contained in the cleaning liquid bump against organic compounds and the like in the scale, the organic compounds and anaerobic bacteria in the drainage pipe can be removed.

[0019] In the system for cleaning the drainage pipe in the movable equipment in accordance with the present invention, the cleaning liquid preferably contains at least one oxycarboxylic acid and at least one sulfamic acid.

[0020] The cleaning liquid containing the at least one oxycarboxylic acid and the at least one sulfamic acid is

particularly advantageous for dissolving calcium compounds in the scale for removal thereof.

[0021] A vehicle according to the present invention is mounted with the aforesaid system for cleaning the drainage pipe in the movable equipment.

[0022] Since the system for cleaning the drainage pipe in the movable equipment is mounted on the vehicle, the vehicle is moved to a site where the movable equipment is parked for cleaning the drainage pipe. This obviates the need for moving the movable equipment to a predetermined site for cleaning the drainage pipe of the movable equipment.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is an explanatory diagram illustrating the construction of a cleaning system according to the present invention; and

Fig. 2 is a sectional view of gas separation means.

## BEST MODE FOR CARRYING OUT THE INVENTION

[0024] Examples of the movable equipment in which the drainage pipe to be cleaned is installed include passenger planes, rail-road coaches, buses and ships.

[0025] As shown in Fig. 1, a drainage pipe 91 is installed in movable equipment 90. The drainage pipe 91 includes a plurality of drainage pipes each having an upstream end connected to a sink or a toilet in a lavatory, and a downstream end connected to a common sewage tank 92.

[0026] Fig. 1 illustrates the overall construction of a cleaning system 10. As shown, the cleaning system 10 is constructed so that a reservoir tank 20 containing a cleaning liquid L is connected to the drainage pipe 91 of the movable equipment 90 by a feed pipe 30 and a suction pipe 50.

[0027] The reservoir tank 20 may be mounted on a vehicle 80 such as a truck. The feed pipe 30 for feeding the cleaning liquid L into the drainage pipe 91 of the movable equipment 90 is connected to the reservoir tank 20 at a position lower than the surface level of the cleaning liquid L. A feed-back pipe 40 to be described later, the suction pipe 50, and a gas suction pipe 60 are connected to the reservoir tank 20 at positions upper than the surface level of the cleaning liquid L. Further, the reservoir tank 20 is provided with a thermometer 21 and a pressure gauge 22 for measuring the inner temperature and pressure of the reservoir tank with the intervention of valves 21a and 22a, respectively. The reservoir tank 20 is further connected to an air transformer 23 for supplying outside air into the reservoir tank when a toxic gas or a combustible gas is generated by the cleaning. The reservoir tank 20 is further connected to a blower 24 for agitating the cleaning liquid L in the reservoir tank 20 and to a blow down pipe 25 for draining

the cleaning agent L from the dissolution tank via valves 24a and 25a, respectively.

**[0028]** The cleaning liquid L to be contained in the reservoir tank 20 may properly be selected depending on the components and amount of the scale deposited in the drainage pipe 91 of the movable equipment 90 and the configuration of the drainage pipe 91. In the case of a passenger plane, for example, the scale deposited in the drainage pipe is mainly composed of calcium compounds, organic compounds and anaerobic bacteria. For removal of the calcium compounds in the scale, a cleaning liquid containing at least one oxycarboxylic acid and at least one sulfamic acid is preferably employed. The organic compounds and the anaerobic bacteria are often deposited in a slime form on the calcium compounds. Therefore, solid chips are mixed in the cleaning liquid L for scraping away the deposited organic compounds and the like. Examples of the solid chips mixed in the cleaning liquid include rice husks and silicone granules.

**[0029]** The feed pipe 30 for feeding the cleaning liquid L into the drainage pipe 91 is connected to a downstream side of the drainage pipe 91 of the movable equipment 90. The feed pipe 30 may be connected to the sewage tank 92 of the movable equipment 90 as shown in the figure.

**[0030]** The feed pipe 30 is branched into two branch feed pipes 31, 31 downstream of a valve 30a, and the branch feed pipes 31, 31 are respectively provided with feed pump means 32, 32 with the intervention of valves 31a, 31a. Flow meters 33, 33 are provided downstream of the feed pump means 32, 32 for monitoring the flow rates of the cleaning liquid L fed into the drainage pipe 91 from the feed pump means 32, 32. Since the feed pipe 30 is branched and the two feed pump means 32, 32 are provided, the pump head capacity of each of the feed pump means can be reduced and the supply amount can be stabilized. Even if one of the pump means is broken, the cleaning liquid L can be fed by driving the other pump means.

**[0031]** The feed-back pipe 40 is connected to the branch feed pipes 31, 31 downstream of the flow meters 33, 33. The feed-back pipe 40 will be described later.

**[0032]** The branch feed pipes 32, 32 join together downstream of a branch point at which the feed-back pipe 40 is diverged therefrom. An end of the joined feed pipe 30 is connected to the drainage pipe 91 of the movable equipment 90 via a pressure indicator 34.

**[0033]** The feed-back pipe 40 is a pipe for feeding a part or all of the cleaning liquid L back into the reservoir tank 20 from the branch feed pipes 31, 31. The feed-back pipe 40 is branched into two branches and joined together. A pressure gauge 41 is provided upstream of a branch point, and feed-back valve means 42 is provided in the branches. A flow meter 43 is provided downstream of a junction of the branches.

**[0034]** The feed-back valve means 42 includes a solution pressure adjustment feed-back valve 44 provided

in one of the branches and an emergency feed-back valve 45 provided in the other branch. The solution pressure adjustment feed-back valve 44 feeds a part of the cleaning liquid L flowing through the branch feed pipes 31, 31 into the reservoir tank 20 according to measurements taken by the pressure gauge 41 and the flow meters 33, 33 provided in the feed pipe 30, thereby serving to maintain the pressure and flow rate of the cleaning liquid L fed into the drainage pipe 91 from the feed pipe 30 at constant levels. The emergency feed-back valve 45 is opened to prevent the cleaning liquid L from flowing into the drainage pipe 91 from the feed pipe 30 when any of the pressure gauges provided in the cleaning system 10 indicates a pressure higher than a predetermined level.

**[0035]** One end of the suction pipe 50 is connected to an upstream side of the drainage pipe 91 of the movable equipment 90, i.e., to the side of the sink and the toilet, and the other end of the suction pipe 50 is connected to the reservoir tank 20.

**[0036]** The cleaning liquid L discharged from the drainage pipe 91, the scale and a gas component in the drainage pipe and the like are sucked as fluid effluent through the suction pipe 50.

**[0037]** Gas separation means 51 is provided in the suction pipe 50, whereby the gas component is separated from the effluent and fed back into the reservoir tank 20 through the gas suction pipe 60, and the liquid and solid components are fed back into the reservoir tank 20 through the suction pipe 50. The gas separation means 51 is provided with a measurement instrument 52 for detecting, adjusting and recording a pressure.

**[0038]** For example, a device which includes a cylindrical vessel 53 having a smaller-diameter lower end and a baffle plate 54 provided diagonally downward in a generally central portion of the vessel 53 as shown in Fig. 2 may be employed as the gas separation means 51. In this device, the effluent sucked from the drainage pipe 91 of the movable equipment 90 is thrown against the baffle plate 54, whereby the gas component flows upward and the liquid and solid components flow downward by gravity for separation of the gas component from the liquid and solid components. The separated gas component is fed back into the reservoir tank 20 through the gas suction pipe 60 connected to an upper portion of the vessel 53. The liquid and solid components are fed back into the reservoir tank 20 through the suction pipe 50 connected to a lower end of the cylindrical vessel 53.

**[0039]** Outside air introduction valve means 61 and gas introduction preventing valve means 62 are provided in this order downstream of the gas separation means 51 in the gas suction pipe 60. These valve means 61, 62 introduce the outside air into the drainage pipe 91 to restore the inner pressure of the drainage pipe 91 to the atmospheric pressure when the inner pressure of the drainage pipe 91 exceeds a predetermined level, whereby the inner pressure of the drainage pipe 91 is

prevented from increasing to a high level. The outside air introduction valve means 61 is a valve for introducing the outside air into the drainage pipe 91 through the suction pipe 50 from the gas suction pipe 60. This valve is closed during a normal operation, and is opened when the pressure in the drainage pipe 91 exceeds the predetermined level. On the other hand, the gas introduction preventing valve 62 closes the gas suction pipe 60 so as to allow the outside air introduced from the outside air introduction valve means 61 to flow into the drainage pipe 91 without flowing into the reservoir tank 20 from the gas suction pipe 60 when the outside air introduction valve means 61 is opened, and is opened during the normal operation.

[0040] In the suction pipe 50, a valve 50a is provided downstream of the gas separation means 51, and solid separation means 55 is provided parallel to the valve 50a.

[0041] The solid separation means 55 separates the solid component from the liquid and solid components separated by the gas separation means 51, and only the liquid component is fed back into the suction pipe 50. Valves 55a, 55a are respectively provided on upstream and downstream sides of the solid separation means 55. A filter, for example, may be employed as the solid separation means 55.

[0042] When the valves 55a, 55a are opened and the valve 50a is closed, the fluid flowing through the suction pipe 50 flows into the solid separation means 55 and, after the solid component is separated, only the liquid component flows into the reservoir tank 20. When the valves 55a, 55a are closed and the valve 50a is opened, the fluid flowing through the suction pipe 50 is introduced into the reservoir tank 20 without flowing through the solid separation means 55.

[0043] Vacuum pump means 26 is connected to the reservoir tank 20 via a valve 26a. The vacuum pump means 26 sucks gas from the reservoir tank 20 to maintain the inside of the reservoir tank 20 at a negative pressure.

[0044] A deodorization tower 27 for deodorizing the sucked gas is connected to a downstream side of the vacuum pump means 26. A pump 28 for circulating a deodorant is connected to the deodorization tower 27 via a valve 28a. The gas sucked from the vacuum pump means 26 passes through the deodorization tower 27 thereby to be deodorized, and emitted to the outside.

[0045] The pump means, the valves and the like described above are electrically connected to each other for actuation thereof or opening and closing thereof on the basis of measurements taken by the thermometers, the pressure gauges and the flow meters.

[0046] The cleaning system 10 is mounted on a deck of a vehicle such as a truck, and transported to a site where the movable equipment having the drainage pipe to be cleaned is parked for cleaning the drainage pipe.

[0047] An explanation will be given to how to clean the drainage pipe 91 of the movable equipment 90 by

utilizing the vehicle 80 mounted with the cleaning system 10 having the aforesaid construction.

[0048] A cleaning liquid L containing L-malic acid and citric acid as the oxycarboxylic acid and amidosulfonic acid as the sulfamic acid and containing rice husks as the solid chips is filled into the reservoir tank 20, and the blower 24 is actuated to agitate the cleaning liquid L.

[0049] The vehicle mounted with the cleaning system 10 is moved to the vicinity of the movable equipment 90. After sewage accumulated in the drainage pipe 91 and the sewage tank 92 of the movable equipment is discharged, an end of the feed pipe 30 is connected to the drainage pipe 91 (or the sewage tank 92), and an end of the suction pipe 50 is connected to the upstream end of the drainage pipe 91.

[0050] After completion of the pipe connection, the feed pump means 32, the vacuum pump means 26 and the air transformer 23 are actuated.

[0051] By the actuation of the feed pump means 32 and the vacuum pump means 26, the cleaning liquid L is fed into the drainage pipe 91 from the feed pipe 30.

[0052] At this time, the pressure adjustment feed-back valve 44 of the feed-back valve means 42 adjusts a ratio of valve opening according to measurements taken by the flow meters 43, 43 and the pressure gauge 41.

[0053] The drainage pipe 91 is filled with the cleaning liquid L by suction to a negative pressure by the vacuum pump means 26. Thus, deposited organic compounds and anaerobic bacteria are gradually scraped away by the solid chips in the cleaning liquid L. Further, calcium compounds are gradually dissolved by the oxycarboxylic acid and the sulfamic acid in the cleaning liquid L.

[0054] The cleaning liquid L flows into the suction pipe 50 from the drainage pipe 91. At this time, gas in the drainage pipe 91 is discharged together with the cleaning liquid L into the suction pipe 50. When the cleaning liquid L is sucked together with the gas from the suction pipe 50, the gas is liable to flow back in the form of bubbles through the suction pipe 50, resulting in bad flow. Therefore, the gas component is separate by the gas separation means 51, and fed back into the reservoir tank 20 through the gas suction pipe 60. The cleaning liquid L from which the gas is separated is fed back into the reservoir tank 20 through the suction pipe 50.

[0055] In the case of the passenger plane, the cleaning liquid L flows around the cleaning system 10 in about two to three minutes. Since the organic compounds and the anaerobic bacteria in the scale are mostly removed by continuing the cleaning for about 20 minutes, the solid chips are thereafter unnecessary. Therefore, the valves 55a, 55a are opened and the valve 50a is closed to remove the solid component from the cleaning liquid L by the solid separation means 55. Thus, only the liquid component is fed back into the reservoir tank 20.

[0056] Thereafter, the cleaning is continued for about one hour, whereby the calcium compounds in the drainage pipe 91 are completely removed. After the scale in the drainage pipe 91 is completely removed, the feed



pump means 32 and the vacuum pump means 26 are stopped, and the cleaning liquid L remaining in the drainage pipe 91 and the sewage tank 92 are removed. Thus, the cleaning operation is completed.

[0057] When measurements taken by the pressure gauges 22, 34, 41, 52, the flow meters 33, 43 and the thermometer 21 are out of the predetermined levels during the cleaning, an abnormality occurs in the cleaning system 10 or the drainage pipe 91. In such a case, the inner pressure of the drainage pipe 91 increases to a high level, resulting in leakage of the cleaning liquid L from the drainage pipe 91. Therefore, the emergency feed-back valve 45 of the feed-back pipe 40 is opened, whereby the cleaning liquid L in the feed pipe 30 is fed back into the reservoir tank 20 through the feed-back pipe 40. Thus, the cleaning liquid L is prevented from flowing into the drainage pipe 91 to prevent the inner pressure of the drainage pipe 91 from increasing to a high level.

[0058] Further, the outside air introduction valve means 61 of the gas suction pipe 60 is opened and the gas introduction preventing valve 62 is closed to introduce the outside air into the drainage pipe 91 from the outside air introduction valve means 61 through the gas discharge pipe 60. Thus, the inner pressure of the gas discharge pipe 91 is not increased higher than the atmospheric pressure.

#### INDUSTRIAL APPLICABILITY

[0059] The system for cleaning the drainage pipe in the movable equipment in accordance with the present invention is useful as a system which is capable of cleaning the drainage pipe in a short time for removal of the scale without detaching the drainage pipe from the movable equipment.

#### Claims

1. A system for cleaning a drainage pipe provided in movable equipment comprising:

a reservoir tank containing a cleaning liquid;  
a feed pipe connecting the reservoir tank and a downstream side of the drainage pipe of the movable equipment and including feed pump means for feeding the cleaning liquid to the downstream side of the drainage pipe from the reservoir tank;  
a suction pipe connecting an upstream side of the drainage pipe and the reservoir tank; and vacuum pump means for sucking gas from the reservoir tank;

wherein the suction pipe is provided with gas separation means for separating gas from gas, liquid and solid sucked from the drainage pipe;

wherein a gas suction pipe for feeding the separated gas back into the reservoir tank is connected parallel to the suction pipe between the gas separation means and the reservoir tank;

wherein the feed pump means and the vacuum pump means are actuated to maintain the inside of the drainage pipe at a negative pressure, to feed the cleaning liquid into the drainage pipe from the reservoir tank through the feed pipe, and to cause the cleaning liquid to flow toward the upstream side of the drainage pipe, whereby scale deposited in the drainage pipe is removed and the removed scale is sucked together with the cleaning liquid through the suction pipe and, after only the gas is separated from the gas, the liquid and the solid by the gas separation means, the liquid and the solid are fed back into the reservoir tank through the suction pipe, and the gas is fed back into the reservoir tank through the gas suction pipe.

2. The system for cleaning the drainage pipe in the movable equipment according to claim 1, further comprising:

a feed-back pipe diverged from the feed pipe on a downstream side of the feed pump means and connected to the reservoir tank;

wherein the feed-back pipe is provided with a feed-back valve device for maintaining a pressure of the cleaning liquid fed into the drainage pipe through the feed pipe at a substantially constant level and, when the pressure of the cleaning liquid exceeds a predetermined level, feeding a part or all of the cleaning liquid back into the reservoir tank.

3. The system for cleaning the drainage pipe in the movable equipment according to claim 1 or 2, further comprising:

outside air introduction valve means provided in the gas suction pipe for introducing outside air to a downstream side of the gas separation means; and  
gas introduction preventing valve means provided on a downstream side of the outside air introduction valve means for closing the gas suction pipe for prevention of introduction of the gas into the reservoir tank;

wherein the outside air introduction valve means is closed and the introduction preventing valve means is opened during a normal operation and, when an inner pressure of the drainage pipe exceeds a predetermined level, the outside air introduction valve means is opened and the introduction preventing valve means is closed for adjustment of the inner pressure of the drainage pipe.

4. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 3, wherein solid separation means for separating the solid is connected parallel to the suction pipe between the gas separation means and the reservoir tank. 5
5. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 4, wherein the cleaning liquid contains solid chips. 10
6. The system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 5, wherein the cleaning liquid contains at least one oxycarboxylic acid and at least one sulfamic acid. 15
7. A vehicle mounted with the system for cleaning the drainage pipe in the movable equipment according to any of claims 1 to 6. 20

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FIG. 1

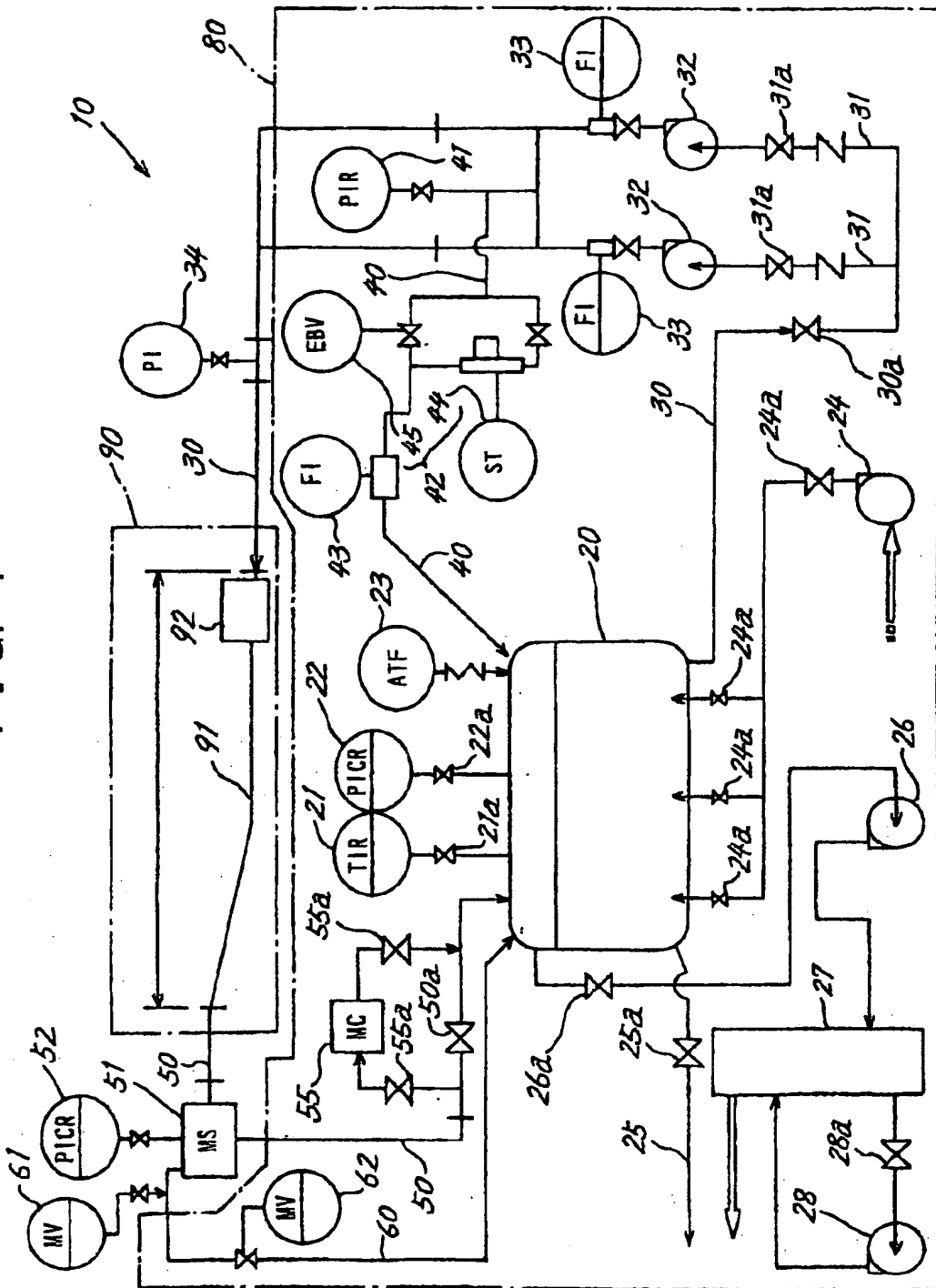
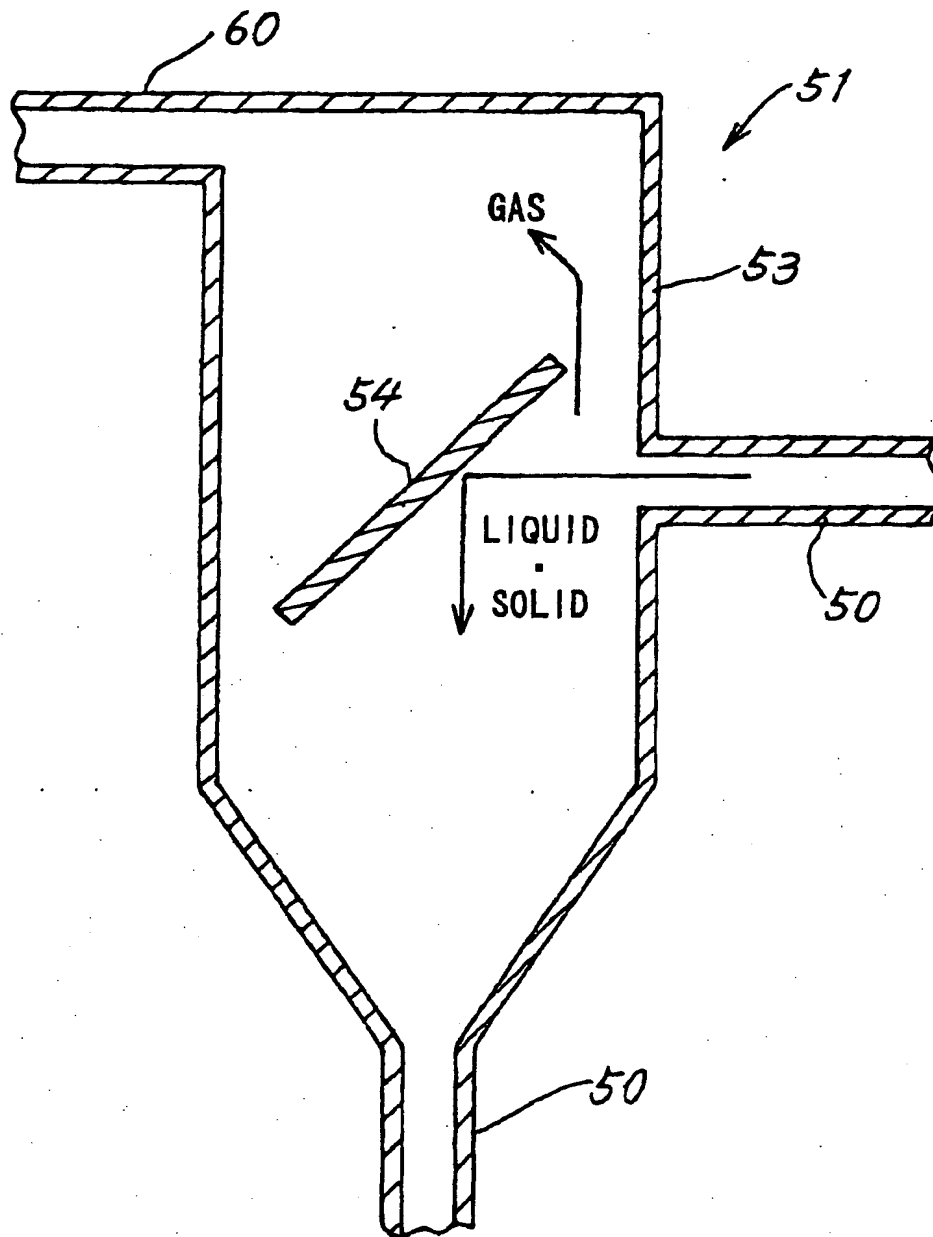


FIG. 2



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/07756

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl. <sup>7</sup> B08B 9/027		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) Int. Cl. <sup>7</sup> B08B 9/027		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1940-2001 Toroku Jitsuyo Shinan Koho 1994-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-285675 A (Japan Steel & Tube Construction Co., Ltd.), 19 October, 1999 (19.10.99) (Family: none)	1, 4, 5-7
A		2-3
Y	JP 6-58435 B2 (Toshiba Corporation), 03 August, 1994 (03.08.94) (Family: none)	1, 4, 5-7
A		2-3
Y	JP 2717627 B2 (Ryobi, Limited), 14 November, 1997 (14.11.97) (Family: none)	5
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 07 December, 2001 (07.12.01)		Date of mailing of the international search report 18 December, 2001 (18.12.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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